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Chimney construction by Chironomus riparius larvae in response to hypoxia: Microbial implications for freshwater sediments

Stief P., Nazarova L., De Beer D.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Many shallow aquatic ecosystems with high nutrient loads experience periods of O2 depletion that evoke behavioral responses by macrobenthic organisms. The sediment-dwelling midge larva Chironomus riparius reduces its deposit-feeding activity and allocates more time to burrow ventilation during periods of hypoxia. We investigated another striking behavioral adaptation of this species, i.e., the elongation of U-shaped sediment burrows to chimneys that tower above the sediment surface. Chironomus riparius larvae gradually abandoned burrow construction and took up chimney construction when exposed to hypoxic conditions in laboratory microcosms. Microsensors were used to show that the chimneys were oxic sediment compartments that were periodically irrigated by the larvae with oxygenated surface water. O2 uptake rates per unit interface area were significantly higher for chimneys than for the flat sediment surface. This observation was consistent with the dense colonization of the chimneys by bacteria. Chimneys may facilitate the larval acquisition of both O2 for respiration and microbial biomass for food. Given the mass abundance of C. riparius in many polluted and O2-deficient habitats, the chimneys also may contribute significantly to the patchiness of the benthic microbial community in terms of structure and function. In particular, the presence of chimneys might favor aerobic bacterial populations and their metabolism. © 2005 by The North American Benthological Society.

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Keywords

Animal-microbe interaction, Biogenic structure, Chironomidae, Diffusive oxygen uptake, Freshwater sediment, Macrofauna, Microsensor, Oxygen depletion, Sediment bacteria, Sediment microcosm